

Another great modern theory is that of elliptic modular functions, with its development, that of automorphic functions. In a letter to Borchardt ("Crelle," vol. lxxxiii. (1877)) Dedekind pointed out the importance of the function he calls the *Valenz*; essentially this is no other than the modular function $j(\omega)$, which enjoys the property that $j(\omega) = j(\omega^1)$ if, and only if, $\omega^1 = (\alpha\omega + \beta)/(\gamma\omega + \delta)$ where $\alpha, \beta, \gamma, \delta$ are real integers such that $\alpha\delta - \beta\gamma = 1$. This introduction of j as fundamental, instead of Hermite's ϕ, ψ functions, marks an epoch in the theory; it should be noted, however, that H. J. S. Smith had practically reached similar results as early as 1865 (see his report on the Theory of Numbers, Arts. 125 ff.).

We now pass on to Dedekind's work in the theory of numbers. Gauss extended the theory so as to include complex integers $m + ni$, and proved that all the usual rules, especially that of the unique resolution of an integer into prime factors, still remained valid. Kummer investigated algebraic integers derived from the period-equations of cyclotomy, and was confronted by the vexatious fact that the theorem about prime factors broke down; thus we might have $\alpha\beta = \gamma\delta$ with $\alpha, \beta, \gamma, \delta$ all integral, each irresolvable in the field considered (and in that sense prime), yet γ essentially differing from α, β by having a different norm. By the invention of ideal primes, Kummer overcame the difficulty, so far as these cyclotomic integers were concerned. His discoveries naturally suggested a definition of an algebraic integer in general, and the problem of defining its prime factors. Dedekind first gave a complete solution in supplement xi. of the third edition (1879) of Dirichlet's "Zahlentheorie"; this is undoubtedly one of the finest mathematical works that have ever been written, and although in the fourth edition (1894) the method is simplified, the original exposition should always be read, and in some ways is unsurpassed, not to say unsurpassable. Briefly, the author establishes the notions of corpus (or field), ideals and their bases, discriminants, including that of the field considered; he proves the general laws of divisibility for every field, and in particular shows how to factorise the real integral prime factors of the discriminant of the corpus—one of the main difficulties of the theory. Besides this, he discusses systems of units, the composition and equivalence of ideals, their connection with the theory of forms, and the problem of finding the number of non-equivalent classes for a given field. All these results are of the highest generality and importance; and every arithmetician, who wishes to advance the theory, must be familiar with them.

In conjunction with H. Weber, Dedekind published in "Crelle," vol. xcii. (1882), a long and important memoir on algebraic functions of one variable. The main feature is the discussion of "algebraic divisors," which play much the same part here as ideals do in an arithmetical field. They allow us to gain a precise conception of a "place" on a Riemann surface, and lead in a

remarkably simple way to proofs of the invariance of the *deficiency* (*genre, Geschlecht*) of the surface, the Reimann-Roch theorem, and so on. Consideration of expansions in a variable t is reduced to a minimum, though (as pointed out by Weierstrass) it cannot be avoided altogether. The methods of this memoir have been developed by Hensel and Landsberg in their treatise on algebraic functions; it seems to us that they form a happy mean between merely heuristic methods and the very dry presentation of the Weierstrassian school.

Another subject on which Dedekind wrote some valuable notes is the theory of groups; however, this is not the place to give a list of his writings. It is to be hoped that they will be published in a collected form, as some of them are not easily accessible; they are not voluminous, and, so far as our experience goes, they are remarkably accurate, so there is no reason for delay. G. B. M.

NOTES.

A CONFERENCE convened by the president and council of the Royal Society was held at Burlington House on Wednesday, March 22, to consider the desirability of establishing a Conjoint Board of Scientific Societies for the purpose of organising scientific effort in this country. Delegates from the following societies attended to confer with the president and council of the Royal Society:—Royal Society of Edinburgh, Royal Society of Arts, Royal Anthropological Institute, Royal Astronomical Society, Royal College of Physicians, Royal College of Surgeons, Royal Geographical Society, Royal Institution, Institution of Civil Engineers, Institution of Electrical Engineers, Institution of Mechanical Engineers, Institution of Mining Engineers, Institution of Naval Architects, Institute of Chemistry, Society of Chemical Industry, British Association, Chemical Society, Geological Society, Linnean Society, London Mathematical Society, Physical Society, Physiological Society, Zoological Society. The following resolution was passed unanimously, and a committee was appointed to draft a scheme for giving effect to the resolution and to report thereon to a future meeting, viz.:—"This meeting considers that it is desirable to establish a Conjoint Board of Scientific Societies for the purpose of (1) promoting the co-operation of those interested in pure or applied science; (2) supplying a means by which the scientific opinion of the country may, on matters relating to science, industry, and education, find effective expression; (3) taking such action as may be necessary to promote the application of science to our industries and to the service of the nation; (4) discussing scientific questions in which international co-operation seems advisable."—We are glad that the Royal Society has taken this step towards the organisation of scientific activities for the promotion of national welfare. The necessity for the unity of effort contemplated in the principles embodied in the foregoing resolution led to the establishment of the British Science Guild in 1905; and Sir Ronald Ross, in the *Times* of March 29, expresses the opinion that the business affairs of science would be better entrusted to such a separate body as the guild than to a board of scientific societies, the members of which are chiefly interested in the publication and discussion of scientific papers.

ON February 23 the French Academy of Agriculture held its annual meeting. There is always a touch

of style and of charm in French men of science, and the meeting was made into a little festival. A bust of Pasteur was installed in the place of honour, a prize was decreed to M. Schloesing, that veteran of the Académie des Sciences, who is now in his ninety-second year, and a most admirable address was given by M. Gaston Bonnier. It is true that English men of science, likewise, are well able to instal busts, decree prizes, and give addresses. But France does it better, for she is not afraid, as we are, of magniloquent oratory. And M. Bonnier not only gave his audience an address, but also read them a poem, "A la gloire de Pasteur"—a poem which won the Grand Prix of the Académie Française last year, the work of M. Charles Richet, professor of medicine in Paris, a man honoured by all physiologists in France and over here. This noble poem is published, with M. Bonnier's address, in the *Revue Scientifique*, March 11-18. The reference to Lister is delightful:—

Honneur à toi, Lister, qui, seul dans cette foule,
T'opposant aux clameurs des savants et des sots,
Pendant qu'un vain torrent de critiques s'écoule,
En admirant Pasteur, sus dompter nos fléaux.

But the whole poem deserves study. Truly, a pleasant little festival of gratitude, goodwill, and reverence; and while these quiet men of science were celebrating in Paris the glory of Pasteur, the batteries of Verdun were thundering out the everlasting glory of France.

THE *Times* and other London daily papers recently made reference to Dussaud's invention of the so-called "cold light" which, it was suggested, was being used for the searchlights mounted on Zeppelins. So far as we have been able to ascertain, the device rests on the plan of overrunning a metallic filament lamp at anything from 50 to 150 per cent. higher voltage than the normal. The candle-power of a filament lamp progresses approximately as the 3-6th power of the voltage, and the efficiency of an overrun lamp is high. The safety of the filament is secured by applying the current only momentarily, and the flicker of the light is avoided by employing a nest of lamps, which are lighted in succession by the use of a motor-driven rotary switch provided with the appropriate number of contacts. The British patent specification speaks of "low-voltage lamps" (less than 25 volts), which restriction may be conditioned by the length of time required to raise the filament to incandescence. The device has been applied to cinematograph lanterns, the interval between the excitation of two successive lamps being arranged to correspond with the interval between successive pictures.

An article on recent Zeppelins appears in the *Times* of March 25, under the name of Mr. George Prade. It appears to be the most trustworthy statement yet available, and is based on an examination of the remains of LZ. 77, brought down by French artillery near Révigny. Super-Zeppelins are dismissed as products of the imagination, and the latest Zeppelin proves to be a very natural outcome of the results of prior experience. LZ. 77 appears to have weighed 32 to 33 tons, and to have carried $1\frac{1}{2}$ tons of bombs. Its defensive armament consisted of six machine-guns, used in pairs on the top and two cars, and nothing in the nature of cannon was found on the airship. From the dimensions, length 525 ft. and diameter 55 ft., it appears unlikely that the highest speed attainable with the engines developing the full 900 to 1000 h.p. would exceed 65 m.p.h., a speed much below that of recent aeroplanes. It may be doubted whether the pointed tail now adopted is intended to reduce resistance, and the form is more probably due to considerations relating to manœuvring and control. The height of the

airship at the beginning of its flight is said to be 6000 ft.; the burning of fuel on the outward journey, together with the discharge of bombs, would give 10,000 ft., the last 2000 of which would occur at a great rate. Germany is estimated to have about forty Zeppelins at the present time, and to be producing new ones at a rate of perhaps thirty-five per year. Most of the existing airships are used for patrolling and scouting over the North Sea, this being their legitimate offensive function.

A MEETING was recently held in Manchester, under the presidency of the Lord Mayor, of engineers and others called together by the Council for the Organisation of British Engineering Industry, to hear an address by Mr. T. C. Elder, of the British Electrical and Allied Manufacturers' Association. It was pointed out that whilst we are now engaged in a deadly military struggle with Germany, we are also engaged in a scarcely less vital economic strife which is going on now, and will increase in intensity after the struggle of arms has ceased. The measures of defence mainly suggested were chiefly of a fiscal and preventive character such as one speaker suggested, namely, that of putting "a ring fence round Germany." So long, however, as our manufacturers choose to look for a remedy in purely fiscal changes, so long will they fail of any effective defence against German productive enterprise, for it is clear to any impartial inquirer that her industrial position is due to her lavish educational provision for all grades of education and to the encouragement given to pure and applied science more than to any other cause. Many important "key" industries are in her hands because of the perfection to which the products required have been brought. Amongst these, dye products stand pre-eminent with an annual importation of nearly two millions, of which 1,800,000l. come from Germany, vitally affecting an industry, that of textiles, valued at 200,000,000l., and employing about one and a half million people. The plain truth of the matter is, as a writer dealing with the history of "British Dyes, Ltd.," recently stated, "that the Germans held the coal-tar colour industry in their hands because they deserved it," and until we take like far-seeing educational measures, our triumph in this rivalry will not be gained.

WE regret to learn of the death of Prof. O. Lignier, professor of botany in the University of Caen, and of distinguished eminence by his work in palæobotany.

THE family of Lieut.-Col. C. Stonham, whose death was announced in *NATURE* of February 24, has presented his collection of British birds to his old school, the King's School, Canterbury.

IN the course of a review in last week's *NATURE*, "G. B. M." referred to a report that the library of the Patent Office had been closed as a war economy. We are glad to be assured that this is not the case; and in the interests of those who find the library of value we hasten to announce that it will remain open as usual.

THE *Lancet* announces that the annual oration of the Medical Society of London is to be given this year by Sir St. Clair Thomson, who has selected for his subject "Shakespeare and Medicine." The date has been fixed for Monday, May 1, so as to bring the oration into line with the official Shakespearean celebrations.

WE are very glad to be able to record that Prof. Mark Baldwin, who was reported to have been lost by the torpedoing of the cross-Channel steamer *Sussex* on Friday last, is safe at Wimereux, with Mrs.

Baldwin. Their daughter has, however, been seriously injured, and is in hospital. Prof. Baldwin was on his way to Paris, after delivering the Herbert Spencer lecture at Oxford, summarised in last week's NATURE (p. 93).

THE *Times* correspondent in the Balkan Peninsula reports that the substitution of the Gregorian Calendar for the Julian or Eastern has been voted by the Bulgarian Chamber. He adds:—"The adoption of this change, which has been long delayed on account of the opposition of the Russian Heirarchy, is naturally a demonstration against Russia, and will be generally attributed to a desire to widen the chasm separating the two States."

At the third annual general meeting of the Institution of Petroleum Technologists, held on March 22, Sir Boverton Redwood, Bart., retired from the presidency in conformity with the by-laws (after two years' tenure of that office), and was succeeded by Prof. J. Cadman. The vice-presidents and council for the ensuing year are:—*Vice-Presidents*: The Rt. Hon. Lord Cowdray of Midhurst, Sir Thomas H. Holland, and Sir Boverton Redwood, Bart. *Council*: A. C. Adams, H. Allen, Sir Robert Balfour, Bart., Capt. R. W. Barnett, H. Barringer, Dr. G. T. Beilby, E. R. Blundstone, A. Campbell, J. T. Cargill, Major A. Cooper-Key, E. H. Cunningham Craig, A. W. Eastlake, C. Greenway, T. C. Palmer, Dr. F. Mollwo Perkin, and R. Redwood.

THE Christiania correspondent of the *Morning Post* reports that Capt. Roald Amundsen, who traversed the north-west passage in the *Gjoa* and led the Norwegian Expedition to the South Pole, has resumed his preparations for an expedition to the North Pole, which were suspended on the outbreak of the war. A short time before that event the Storthing voted 12,000l. as a subscription towards the expenses of the enterprise, but having regard to the war, Capt. Amundsen did not accept the money. He thinks, however, that the time has now come to make arrangements to start next summer. He proposes to leave Point Barrow, North Alaska, and to drive with the ice over the polar basin.

MORE detailed accounts of the report of the South African Government Committee on the Rand earthquakes have now reached this country. The shocks are described as consisting practically of a single sharp vibration, the sensation being similar to that produced by the fall of a heavy body on the ground. On the surface, the shocks were sometimes strong enough to open cracks in house walls. Underground, the effects were occasionally disastrous, causing loss of life and damage to the mines. Yet the distance to which the shocks were felt was small, only rarely amounting to as much as seven miles. This implies a slight depth of origin, and the conclusion at which the committee arrives scarcely admits of doubt that the shocks are due to mining operations and not to natural causes. The committee considers that the pillars left have not been strong enough to support the roof, and that their sudden crushing gives rise to the shocks. Some of the slighter tremors are attributed also to the fracture and settling of the overlying strata.

THE President of the Board of Trade has decided to appoint committees to consider the position of certain important British industries after the war, especially in relation to international competition, and to report what measures, if any, are necessary or desirable in order to safeguard that position. The following committees have accordingly been constituted:—For the iron, steel, and engineering indus-

tries: Sir Clarendon Hyde (chairman), Mr. A. Balfour, Sir Hugh Bell, Bart., Mr. A. J. Hobson, Sir Halliwell Rogers, and Mr. D. Vickers. For the shipping and shipbuilding industries:—Sir A. A. Booth, Bart. (chairman), Prof. W. S. Abell, Sir Archibald Denny, Bart., Sir Edward Hain, Capt. H. B. Hooper, Mr. J. Readhead, Mr. O. Sanderson. All communications relating to the above committees should be addressed to Mr. Percy Ashley, the Board of Trade, S.W. The constitution of a committee for the textile industries will be announced shortly.

WE record with much regret that 2nd Lieut. Kenneth R. Lewin, protozoologist to the Rothamsted Experimental Station, was killed in France on March 9. Mr. Lewin took the Natural Science Tripos at Cambridge, and, influenced by Prof. Sedgwick, chose protozoology as the special subject of his life-work. After his course at Cambridge, he spent some months at Munich under Prof. Hertwig, and at the Naples Biological Station. On his return he became assistant to Prof. Nuttall, and then in 1913 he was appointed protozoologist to the Rothamsted Experimental Station, where his work speedily justified the promise of his college days. His investigations were made in conjunction with C. H. Martin, who also lost his life in Flanders last May, and the combination proved most happy. The problem presented to Lewin at Rothamsted was to find out first of all whether there was a trophic protozoan fauna in the soil, and, secondly, what was its mode of life. He began with Martin's film method, the details of which he improved, and later introduced a bubbling method, both of which he used with considerable success on certain types of soil. The results are given in two papers published jointly with Martin, one in the *Phil. Trans.* for 1914, the other in the *Journal of Agricultural Science*. This last paper was finished just after the outbreak of the war. So soon as it was done, Lewin returned to Cambridge and joined the O.T. Corps, afterwards obtaining a commission in the 6th D.C.L.I. An able zoologist with abundant vigour of thought and freshness of outlook, and at the same time much kindness and sympathy towards all with whom he had to deal, it is deplorable that the distinguished scientific career which was before Lewin has been abruptly ended by his death.

MR. SELOUS, in the *Zoologist* for February, continues his diary of ornithological observations made in Iceland during June and July, 1912. He has much that is worth recording to tell of the curious courtship displays of the red-necked phalarope, and incidentally of the habits of many other birds frequenting the same haunts. One is compelled, however, to hunt laboriously for these good things amid a mass of quite unnecessary detail. We further venture to think that Mr. Selous would have seen much more of the courtship displays of the birds he was more especially interested in if he had commenced his observations at daybreak, for it is at this time and onwards for the next hour or so that their greatest intensity is developed.

A VIVID insight into the habits of the waterhen, coot, redshank, ringed plover, and lapwing, especially during the reproductive period, is given by Miss E. L. Turner in *British Birds* for March. In a series of impressionist pictures, delightfully flippant, and illustrated with admirable photographs, Miss Turner describes the courtship displays of these birds and their desperate jealousies in regard to their territorial rights during the breeding season. The scene of her studies was the Mere in Holy Island, and here, between

March and June, she achieved some really useful work. The unneighbourly character of the waterhen has long been recognised, but few, probably, realise the pugnacity it displays when fighting for territory or when driving off trespassers when that estate has been won. The true character and the importance of this aggressiveness has only recently been realised, having been first clearly demonstrated in the case of the British warblers by Mr. H. Eliot Howard. Until then the battles between males had always been regarded as contests between rival males for the possession of females. Miss Turner's observations in this article entirely bear out the newer interpretation.

In the forest of Soigne, at the gates of Brussels, Belgium possesses two Government arboretums, arranged on the group system, planted with exotic trees under forest conditions. These were founded about twenty-five years ago, and, conditions being very similar to those which obtain in England, they afford useful object-lessons, possibly very little known, which should be studied by British foresters. Fortunately, these arboretums were visited by Mr. D. E. Hutchins, formerly principal forest officer in British East Africa, in the summer of 1913, and his account is published in the Transactions of the Royal Scottish Arboricultural Society, vol. xxx., pt. 1, of January, 1916. Among trees which will not grow in Belgium may be mentioned *Sequoia sempervirens* and many Japanese trees which require a heavy rainfall. Douglas fir is the fastest-growing conifer in both arboretums, and among the oaks *Quercus rubra* has given the best results. Details of the growth of the various trees, with girth measurements and age, are given in all cases.

PROF. A. HENRY contributes an illustrated article on the black poplars to the Transactions of the Royal Scottish Arboricultural Society, vol. xxx., January, 1916. He deals especially with the wild European and east North American species and their various forms and hybrids. The American species *Populus deltoides* bears cilia on the margins of the leaves, and glands on the base of the leaf in front, and the flowers have 40-60 stamens and 3-4 stigmas. In the European poplar *P. nigra* the leaf characters of the American plants are absent, and the stamens are only 12-25 and stigmas 2. It is remarkable that the European species, though well known to the pre-Linnæan British botanists, was named by Michaux from introduced species growing on the banks of the Hudson and in New York City. The Lombardy poplar is only a sport from this species, and originated probably as a single tree between 1700 and 1720 in Lombardy, and practically all the examples are males. The only known female Lombardy is at Kew, and its history is unknown. The numerous hybrid poplars are described in detail, and their value as timber trees is discussed. Some vigorous hybrids—e.g., *P. generosa*—have been produced by Prof. Henry.

MR. CARLOS AMEGHINO has contributed to *Physic* (vol. ii., No. 9, pp. 36-9) a useful French abstract of his important memoir on a femur of the extinct ungulate *Toxodon*, which seems to have been penetrated during life by an implement of quartzite, and suggests the great antiquity of man in the Argentine region of South America. The *Toxodon* is considered to be of a small species, older than the Pampean formation, perhaps even Pliocene, and the bone was found in a deposit at Miramar, which may well be of this age. The quartzite implement is actually embedded in the great trochanter of the femur, where the growth of bone has partly enveloped it.

PROF. R. A. DALY, of Harvard, has stated his views as to the "Origin of the iron ores of Kiruna" in a memoir issued by the Nordiska Bokhandel of Stockholm as part of the *Vetenskapliga och praktiska undersökningar i Lappland* (1915). The visit of many members of the International Geological Congress of 1910 to the magnetite mountain of Kiiruna-vaara, under the guidance of Herr Lundbohm, aroused wide interest in the theoretical questions connected with the massive band of ore. Prof. Daly expresses himself with caution, but he regards the porphyritic igneous rocks as originally intrusive in the form of a laccolite, the uptilting of their sheets being due to later earth-movement. The magnetite became separated, probably by gravitation, from the igneous magma, and even the small and often angular blocks of magnetite in the quartz-porphyry are held by the author to be local segregations, akin to the main ore body, and not inclusions.

ON October 3, 1915, a great earthquake was recorded shortly after 7 a.m. at Eskdalemuir and other observatories in this country. The epicentre was estimated to lie in one of the western United States. It now appears that this earthquake must have been one which occurred in Pleasant Valley, Nevada, at 10.54 p.m. (Pacific standard time) on October 2, and is described by Mr. J. Claude Jones in the Bulletin of the Seismological Society of America (vol. v., 1915, pp. 190-205). If it had occurred in a populous district, the earthquake would have ranked as one of the destructive earthquakes of the world. It disturbed an area 800 miles long, from north to south, and 650 miles in width, an area which does not differ much in extent from that affected by the Californian earthquake of 1906. Pleasant Valley runs in a southerly direction from about 40 miles south of Winnemucca. On the east side, it is bounded by the southern half of the Sonoma Range, along the base of which, for a distance of 22 miles, Mr. Jones traced a fresh fault-scarp, nearly vertical, and varying in height from 5 to 15 ft. The movement along this fault, which caused the earthquake, was the latest of a series responsible for the elevation of this part of the Sonoma Range.

MESSRS. EDWARD STANFORD, LTD., have just added two new maps (Nos. 16 and 17) to their series of war maps. No. 17 is a map of the British front in France and Flanders, and is on a scale of half an inch to a mile; it extends from Boesinghe beyond Ypres on the north to Bray-sur-Somme on the south, and is coloured on the layer system, contours being shown at 125 and 250 ft. It thus contains the whole of the 70 miles line of front now held by us. The other map (No. 16), also coloured on the layer system, embraces the whole of the troubled districts in the Balkan Peninsula, including the mouths of the Danube and Constantinople, Salonica, Belgrade, and Serajevo. The scale is 18 English miles to 1 in.

THE relation between cirrus directions as observed in Melbourne and the approach of various storm systems affecting Victoria is the subject of Bulletin No. 10 of the Commonwealth Bureau of Meteorology. Mr. E. T. Quayle records the direction of movement of cirrus clouds in advance of the various types of cyclonic depressions which affect Victoria, and finds close correlations between these and the distance of the trough of the depression. Thus, in the case of the commonest type of depression in Victoria, the so-called Antarctic depression, observations indicate that cirrus movements to the south of west are associated with a trough more than 700 miles away, and north of west

with a trough fewer than 700 miles away. Further, the author contends that his results are of value in forecasting rain. Taking the normal cirrus direction as west, a departure of 8° to the north was associated with general rains, 4° to the south with partial rains, and 12° to the south with a failure in rain. Mr. Quayle contends his results show that cirrus movements can be used as guides in forecasting the weather, and gives some general rules in application to the weather of Melbourne.

THE usual method of cartographical representation of density of population based on the consideration of each census district as a whole has many drawbacks. Not only does it entail frequent sudden breaks in continuity when a district with a high degree of density adjoins one with a low, but it has the fatal objection of being founded on purely arbitrary political divisions. A new and far more scientific method has been worked out by Mr. B. C. Wallis, and described, with specimen maps of Hungary, in the *Geographical Journal* for March, 1916 (vol. xlvii., No. 3). Mr. Wallis has taken the average density for each commune, the smallest area for which there are returns, and, using these figures as "spot heights," applied the principles of contour lines. The result is a justification of the method. In like manner, Mr. Wallis has applied this method to illustrate the distribution of nationalities in Hungary, and has produced an instructive map, which is of far greater usefulness than the old-fashioned and rather meaningless chart in which the percentage of each nationality is given in figures of different colours in each commune. The paper goes on to deal with some of the results of the distribution which the map illustrates.

CALCULATING machines form the principal subject of a paper by M. Leonardo Torres y Quevedo in the *Revue générale des Sciences* (xxvi., 21), under the title, "Essais sur l'Automatique." It deals with the construction and principle of devices, mainly electrical, for performing arithmetical and other operations without human intervention. A possible cause of error, namely, the production of electric sparks, is considered, and a method of obviating this risk is suggested.

RESULTS of magnetical, meteorological, and seismological observations for the month of August, 1915, and the annual report for 1914, of the Royal Alfred Observatory, Mauritius, show that an exceedingly valuable series of results is being secured under the directorship of Mr. A. Walter. A table is given of the means and extremes of the principal meteorological elements for the year compared with previous results from about 1875. Other tables give the monthly departures from average of the various meteorological elements, also the mean hourly velocity of the wind for the eight five-year periods from 1876 to 1914, and other information of a meteorological, magnetical, and seismological character. During the visit of the German cruiser *Emden* to the station at Cocos Island the meteorological instruments were destroyed. Much valuable information is secured by the observatory staff from the logs of ships traversing the Indian Ocean, and by this means details are obtained relative to the formation and movement of cyclones over the Indian Ocean.

ON July 15, 1896, the Pacific coast of Japan was attacked by a tremendous ocean wave, the sea off the coast of Miyato rising and falling alternately. The second crest reached the maximum height, and the oscillation then decayed rapidly. The hypothesis that this disturbance was due to a sudden depression of the sea-bottom over a limited area forms the subject of a

hydrodynamical investigation of the wave motion theoretically produced by such a disturbing cause. This theory, which assumes the sea-bottom to be of uniform depth and the depression to be circular, appears to give results according with those of observation to a reasonable degree of closeness. The times from the beginning of the earthquake to the first wave, the interval between the first and second, and the fact that the second is the highest, are results in which theoretical calculations accord fairly well with results of observation. The paper, which is by Keizo Sano and Kea Hasegama, is published in the Proceedings of the Tokyo Mathematico-Physical Society, viii., 7.

IN pamphlet No. 20 of *Mededeelingen en Verhandelingen* of the Koninklyk Nederlandsch Meteorologisch Instituut (Utrecht, 1915, pp. 24), P. H. Gallé discusses steamer routes from Durban and Cape Agulhas to various parts of the Dutch East Indies. This subject has recently attracted a certain amount of attention on account of the increase of shipping between these points, and since the paper was written Dutch East Indian passenger liners have started going round by the Cape instead of through the Suez Canal. The factors affecting a choice of routes are:—(1) The equatorial counter-current and other easterly currents near the equator; (2) the south equatorial current and the easterly drift south of lat. 35° S.; (3) the West Australian current; (4) the N.E. and S.W. monsoons; (5) the S.E. trade winds; (6) easterly winds south of lat. 30° S.; and (7) westerly winds S. of lat. 35° S. Various charts indicate a region round the Cocos Islands, between lat. 10° and 20° S. and between long. 90° and 105° E. as being more or less free from cyclones, but according to the author the existence of this region is doubtful, and requires further investigation. The publication is chiefly of nautical interest.

THE annual report of the director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington for 1915 shows the large amount of work which has been done by the department both on land and at sea. We have referred as occasion has offered to the magnetic survey work at sea carried out on board the *Carnegie*, which last year devoted herself to the Pacific. The present report announces that the following land surveys have been completed:—Through Central Brazil from Rio de Janeiro to Para; interior of southern China and Mongolia; general magnetic survey of Australia; Australasian and West Pacific Islands; the Belgian Congo and Angola and the south-west coast of Africa. At Washington itself the new buildings have been brought into use, and a considerable amount of reconstruction and improvement of instruments has been accomplished, especially in relation to measurements of atmospheric electricity. Abstracts of thirteen papers which have been published by the staff during the year are appended to the report, which contains a record of work for the good of the world on which the Carnegie Institution may justly pride itself.

A PAPER on the Rangoon River Training Works, by Sir George Cunningham Buchanan, read before the Institution of Civil Engineers on March 21, contains some interesting details of an engineering undertaking of considerable importance. The Port of Rangoon, to-day the third port of the Indian Empire, is situated on the left bank of the river of the same name, which constitutes one of the deltaic mouths of the Irrawaddy, at a distance of about 28 miles from the sea. At this point, which also marks its junction with two other effluents, the stream assumes a very sinuous course, and, swinging round a bend in front

of the town, has for a long time past produced very marked erosion of the right, or concave, bank, with corresponding accretion on the other. It was realised that unless this action could be checked the channel would ultimately be deflected away from the town and the existence of the port jeopardised. The remedial work consisted of a training wall, 13,000 ft. long, constructed of stone rubble laid on a brushwood mattress foundation, with a reinforced concrete superstructure finishing at high-water level of neap tides. The work was begun in 1910 and completed in the spring of 1914, at a total cost of 921,783 $\frac{1}{2}$. The stone—a porphyritic diorite—was mainly obtained from quarries specially opened out on an uninhabited island, some 135 miles distant from Rangoon, situated in the open sea off the Tenasserim coast. The total quantity of stone used amounted to nearly 28 million cubic feet. The mattresses for the foundation absorbed 5 $\frac{1}{2}$ million bundles of brushwood from local jungles.

THE Institution of Electrical Engineers has issued a new edition of its rules for the electric wiring of buildings. They differ chiefly in points of detail from the code issued in 1911. One of the modifications relates to the arrangement of switches and fuses on installations connected to three-wire networks with earthed neutrals, to ensure that the connection to the neutral main shall not be interrupted before those to the outer conductors. Another calls for double-pole switches on all electric heaters rated above 1 kw. The rules are now adopted by fifty insurance companies.

MESSRS. W. HEFFER AND SONS, LTD., Cambridge, announce for early publication "Methods in Practical Petrology," by H. B. Milner and G. M. Part. The work is intended for petrological students and others who wish to make their own rock slices, and will contain chapters on the preparation of rock slices, examination of rock slices, microchemical methods (staining), and mounting of sands and crushed rock material, with an appendix on the preparation of stains.

A NEW monthly periodical entitled *Physiological Abstracts* is about to be issued by Messrs. H. K. Lewis and Co., Ltd., under the editorship of Prof. W. D. Halliburton. We understand that the term "physiological" is used in a wide sense, and that the journal will contain important papers in allied sciences which have physiological bearings; thus, abstracts will be given of papers in comparative physiology and biochemistry, as well as in physiology proper. It is not proposed to print original communications unless there be special reasons for so doing.

OUR ASTRONOMICAL COLUMN.

THE PLANET VENUS.—The nearest approach to the Pleiades will occur about 6 p.m. on Tuesday, April 4. Venus will then appear approximately 2 $\frac{3}{4}$ ° distant from Alcyone, the brightest star of the cluster.

NEW LINES IN THE SPECTRUM OF SILICON.—Prof. A. Fowler, in a paper communicated to the Royal Astronomical Society (*Monthly Notices*, lxxvi., pp. 196–7), gives the following lines in the spark spectrum of silicon, most of them observed and identified for the first time. $\lambda\lambda$ 5740.2 (int. = 10), 4829.4 (4), 4820.1 (3), 4813.7 (2), 3590.5, and 3487.1. All have been found to show the laboratory behaviour characteristic of Lockyer's Group IV. lines (*i.e.* brought out by the strongest condensed discharges), and the four less refrangible also appear in the Harvard reduction of the spectrum of β Crucis (B1, Cru.), which also shows the

previously known lines of Group IV., $\lambda\lambda$ 4089 and 4116.5.

DEFINITIVE ORBIT OF COMET 1802.—First observed by Pons on August 26, 1802, this comet was observed 140 times during a period of forty-one days, describing heliocentrically an arc of 46°. On the basis of the orbit calculated by Olbers from his own observations K. Lundmark has derived the following elements by the method of Schonfeld:— $T=1802.69$; epoch, 1900; $\omega=21^{\circ} 51.7'$; $\varpi=310^{\circ} 54.6'$; $i=56^{\circ} 59.9'$; $\log q, 0.0391$. Perturbations have not been calculated, as the comet was observed for so short a period, and, moreover, a graphical examination showed that the comet in its path through the solar system had nowhere approached the major planets. Identity with comet 1909 I. would give a period of 106.734 years, and the next earlier apparition would be 1695, but the orbit of the comet of that year is not known with the requisite accuracy to establish identity.

A NEW METHOD FOR THE DETERMINATION OF LATITUDE.—The solution of the outstanding problems connected with the variation of latitude is now being sought in variety of methods as contrasted with the uniformity of the international latitude service. In this connection attention is merited by a method proposed and successfully employed by Dr. G. Zappa (*Atti R. Accademia dei Lincei*, vol. iii., p. 69, 1916). The new method is a modification of Struve's, in which high altitude stars are observed in the prime vertical, and the essential improvement consists in the employment of pairs of stars, one E. the other W., chosen so that the observation of both can be made in a short interval of time. It is claimed to afford results comparable with those given by the Horrebow-Talcott method, and may thus possibly serve to clear up the mystery of the Kimura term. The mean error of a latitude deduced from nine pairs of stars (Boss, P.G.C.) is $\pm 0.10''$, whilst the latitude of the Observatory of Capodimonte has been determined with a mean error of $\pm 0.35''$, but the relevant number of observations is not stated. The "Carpe" premium has been awarded to Dr. Zappa for his memoir.

THE PLANE OF THE SOLAR MOTION.—A further paper by Prof. von S. Oppenheim on the subject of stellar motions appears in *Astronomische Nachrichten*, No. 4830, and nominally concerns the plane of the solar motion. Shortly after Kobold's well-known memoir on this subject was published, Harzer showed that the method reduced to the solution of a cubic equation giving the axes of what Prof. Oppenheim now terms the "momenten-ellipsoid." Although the Bessel-Kobold method gave a good value for the right ascension it failed to determine the declination of the apex, and no further attention appears to have been given to the Harzer ellipsoid. Prof. Oppenheim has now found the possible significance of the remaining axes by an application to the case of the geocentric motions of the minor planets. In a recent paper (see *NATURE*, October 21, p. 209) he employed the Bessel-Kobold method to investigate the plane of the solar motion, and incidentally found that the Charlier sectors were divided into two groups, about half giving the normal value for the Ω , whilst for the others the value was found to be $360^{\circ}-\Omega$, as though direct and retrograde stellar motions had been discriminated. The two groups have now been treated separately, and it is stated that the momenten-ellipsoids are enantiomorphous. One axis of each is, of course, directed towards the solar apex; by analogy with the minor planets it appears that the second axis points to the pole of the plane of the solar motion, whilst the third is directed to the ideal centre of the stellar orbital movements.